

C3
Wolf
forming an overlayer over said conductive layer; and

forming a contact in said overlayer and in an overetch amount of said thick region, wherein said contact is formed in said overetch amount of said thick region, wherein said overetch amount has a thickness greater than said first thickness.

REMARKS

Applicant acknowledges that the request for continued examination under 37 CFR 1.114 has been entered.

In the present Office Action, claim 26 has been rejected under 35 USC §112, second paragraph as being indefinite. The Examiner explains that claim 26 does not distinctly claim what the overetched amount is because the claim does not signify what type of variations are encountered. Claim 26 has been amended to explain that the type of variations are variations in the thickness of the overlayer, as stated in the Specification on page 10, lines 10-11. Applicant has also revised claim 26 to remove some unnecessary terminology.

The Examiner objects to claim 48 as being dependent upon a rejected base claim. The Examiner points out that the claim would be allowable if rewritten in independent form. Claim 48 has been rewritten in independent to include all of the limitations of the base claim and therefore is allowable.

The Examiner also rejected claims 21-25, 31, 32, 40-43, and 47 under 35 USC 103(a) as being unpatentable over Matsuo in view of Wolf. Matsuo teaches the formation of a semiconductor memory device. The device contains memory cells that are formed at an active region of a p-type silicon substrate (col. 4, lines 7-8). The device also contains contacts that can

Serial No. 09/008,531
MIO 0012 V2

be formed by dry etching (col. 5, lines 40-46). Matsuo also teaches forming an oxide film over the surface of the first interlayer insulating film (col. 5, lines 30-31).

As the Examiner notes, Matsuo does not teach where the contact is formed in the overlayer by etching. The Examiner also notes that Matsuo does not teach etching an overetch amount of the substantially vertical component such that the contact is formed in the vertical component and in the thick region. The Examiner asserts that this would have been obvious to one of ordinary skill in the art at the time of the invention because Matsuo using an etching technique for forming the contact holes.

The Examiner provides no basis for this assertion. The formation of the contact in the overlayer by using an etching technique is not taught or suggested by Matsuo. Absent any factual basis by the Examiner for this assertion and lack of teaching or suggestion by Matsuo, the argument fails.

Wolf teaches etching silicon and silicon dioxide in fluorocarbon-containing plasmas. Wolf points out that small concentrations of oxide may be added to a fluorocarbon feed gas to increase the etch rates of silicon and silicon dioxide. Wolf also teaches that some tolerable amount of polysilicon material is etched.

The Examiner asserts that Wolf teaches that oxide may be etched selectively to polysilicon material and that some tolerable amount of polysilicon material is etched. Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to form the contact in the overlayer of Matsuo using an oxide etching treatment as in Wolf.

Also, it would have been obvious to have some tolerable overetched amount of the in the vertical component.

There is no teaching or suggestion in either reference to use the etching process taught in Wolf to form the contacts in the overlayer of Matsuo. Even if there was motivation to combine the teachings the present invention would not be taught. Nowhere does Wolf teach the oxide etching selectively to polysilicon. In addition, the tolerable amount of overetching recited in the present invention is much higher than the amount taught in Wolf.

Wolf recited on page 549 that the silicon is not significantly etched. Claim 26 of the present invention recites an overetch amount of the layer of the first conductive material. The claim further states that this overetch amount “is an amount necessary to account for variations in the thickness” of the overlayer. Thus, **slight** overetching is taught in Wolf to be tolerable whereas the overetching claimed in the present invention is intentional and continues into the substantially vertical component of the conductive material. Thus, the present invention is not taught or suggested.

The Examiner next asserts that claims 22-25 would have been obvious. However, claims 22-25 are dependent upon independent claim 21. Independent claim 21 having been proven nonobvious makes claims 22-25 nonobvious.

Next, with respect to claims 40-43, the Examiner asserts it would have been obvious given the teaching of Wolf, that the layer of conductive material of Matsuo would have been etched to some degree and that the contact formed physically in contact with the thick region of

Matsuo would have contacted the thick region at a depth deeper than an upper surface of the thick region.

As stated above, Wolf does not teach or suggest the etching process of the present invention. Furthermore, Matsuo teaches that the contact is formed in contact with the thick region. The present invention recites in claim 40 “forming a contact through the overlayer and in the thick region.” Neither Matsuo nor Wolf teach or suggest forming a contact through the overlayer and in a thick region. Thus, claim 40 is nonobvious. Claims 41-43 dependent from independent claim 40 and therefore are nonobvious.

The Examiner next rejects claims 26-28, 30, 35, 36, 47, and 48 under 35 USC §103(a) as being unpatentable over Bergemont. Bergemont teaches a method of making a semiconductor device utilizing intermediate strips of conductive material that are self-aligned to the drains of the memory cells of the array. The intermediate interconnect strips are formed by depositing a layer of conductive material over the entire array. As the Examiner concedes, Bergemont does not show forming the contact hole which communicates in the localized thick region by overetching an amount of the layer of the first conductive material which communicates with the layer of the first conductive material.

However, the Examiner asserts that it would have been obvious to one of ordinary skill in the art that no etchant used to etch the overlayer material of Bergemont selectively with respect to the first conductive material of Bergemont is capable of being completely selective. The Examiner states further that even if the etch selectively is low it is still an etched amount.

Initially, applicants assume that the rejection of claim 48 on this basis was in error as the Examiner indicated elsewhere in the Office Action that claim 48 contained patentable subject matter. As claim 47 has been canceled and claim 48 has been rewritten in independent form, the rejection as to those claims is moot. Bergemont does not teach or suggest the subject matter of amended claim 48.

With respect to claim 26, the present invention teaches an amount of overetching which is necessary to account for variations in the thickness of the overlayer. Bergemont does not teach or suggest overetching of any fashion, no matter how minute. The Examiner's assertion that it would be inherent that at least some overetching occurs does not in and of itself make the present invention obvious because the present invention specifically teaches and claims intentionally overetching in an amount necessary to account for variations in the thickness of the overlayer. This amount of overetching would not have been obvious to one of ordinary skill in the art in light of Bergemont because Bergemont does not even mention overetching. Thus, the rejection is improper.

Claim 35 has been amended to recite etching the contact hole in the overlayer and an overetch amount of the layer of the first conductive material, the amount of overetching which is necessary to account for variations in the thickness of the overlayer. As explained directly above, Bergemont does not teach or suggest overetching. Therefore, the Examiner's assertion that it would be inherent that at least some overetching occurs does not make the present invention obvious. The present invention specifically teaches and claims overetching in an amount necessary to account for variations in the thickness of the overlayer. This is not

Serial No. 09/008,531
MIO 0012 V2

mentioned in Bergemont; thus the rejection is improper and claim 35, as amended, is in condition for allowance.

Claims 27, 28, 30, and 36 have been rejected under 35 USC §103(a) as being unpatentable over Bergemont. Independent claims 26 and 35 from which claims 27, 28, 30, and 36 depend have been shown to be nonobvious, therefore claims 27, 28, 30, and 36 are also nonobvious.

Finally, claim 29 has been rejected under 35 USC §103(a) as unpatentable over Bergemont in view of Chiang. Chiang teaches a method for forming interconnection for semiconductors wherein the interconnect and metal layer may be made of titanium nitride and the contact plug may include titanium nitride or polysilicon. Bergemont teaches that the layer of conductive material can include titanium nitride. The Examiner asserts that it would have been obvious to one of ordinary skill in the art at the time of the invention to from the first conductive material Bergemont using polysilicon instead of titanium nitride in view of Chiang.

Claim 29 recites that the first conductive material comprises polysilicon. Bergemont does not teach or suggest using polysilicon instead of titanium nitride. Chiang teaches the use polysilicon of the contact plug only, but not for the formation of the interconnect and metal layers. Thus, there is no motivation or teaching that polysilicon can be substituted with titanium nitride for the formation of the first conductive material of the present invention. Furthermore claim 29 depends from independent claim 26 which is shown above to be nonobvious. Therefore, claim 29 is nonobvious.

Serial No. 09/008,531

MIO 0012 V2

For all of the above reasons, applicants submit that claims 21-32, 35, 36, 40-43 and 48 are patentable over the cited art of record. Early notification of allowable subject matter is respectfully solicited.

Respectfully submitted,
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